

Unlimited Muon Collider Luminosity with Fixed Beam Power

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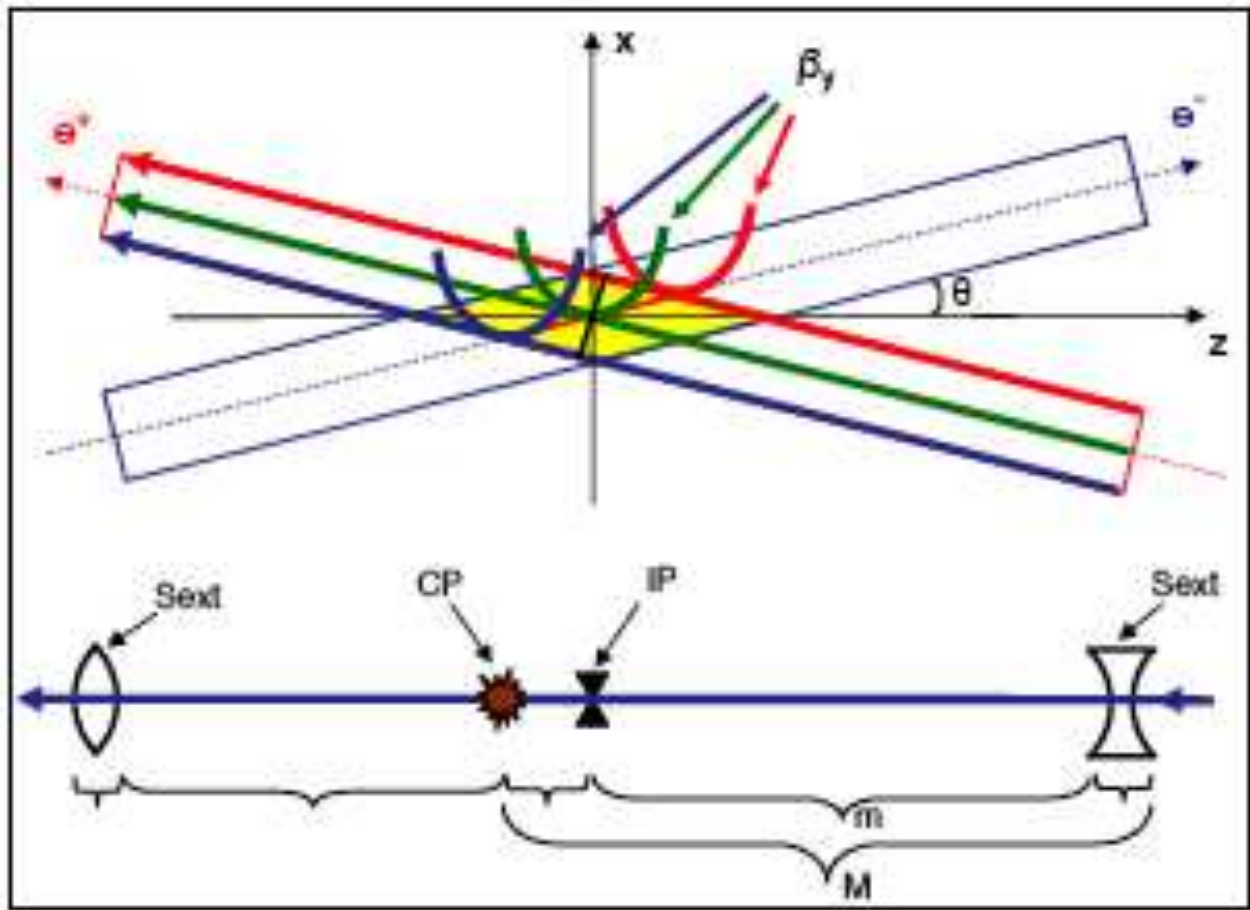
Muon Collider Task Force Meeting
Fermilab
Batavia, Illinois
29 March 2007

SuperB Factory Goals

- Luminosity (10^{36}) = $100 \times$ Belle/BABAR
- Same beam current as Belle/BABAR
- Same number of bunches as Belle/BABAR
- Same bunch length as Belle/BABAR
- Same wall power as Belle/BABAR
- Same cost as Belle/BABAR

Frascati/Novosibirsk SuperB News

Crabbed Waist Betatron Resonances Suppression



- $L \propto N\xi_y/\beta_y$. Raise tune shift and lower β_y .
- Raimondi, Shatilov, Zobov, physics/0702303.

Frascati/Novosibirsk SuperB News

- Adopt an e^+e^- 17 mrad crossing half angle.
Lower horizontal beam width to 4 μm .
 $\sigma_z = \text{bunch length} = 6000 \mu\text{m}$.
Piwinski angle = $\varphi \sim (\sigma_z/\sigma_x)\theta$.
 $\varphi = (6000/4)(0.017) = 25$.
Lower β_y to 200 μm overlap = $\sigma_x/\theta \ll \sigma_z$.
Wigglers cut transverse damping to 32 ms.
Precision magnet ring lowers ϵ_x by 25.
Precision magnet ring lowers ϵ_y by 125.
- Vary β near IP with 2 sextupoles. *Crabbed Waist* cuts resonances $\Rightarrow 0.2 \xi_y$ tune shift.
- Estimate increased luminosity.
- $L \propto N\xi_y/\beta_y$; get 30 from β_y , get 3 from ξ_y .
- $L \propto N\xi_y/\beta_y$; $\xi_y \propto N\beta_y/\sigma_x\sigma_y\sqrt{1+\varphi^2}$; $\sigma = \sqrt{\beta\epsilon}$.
Lose 25 from φ . Get 2300 from spot size.
- Raimondi, Shatilov, Zobov, physics/0702303.

1.5 TeV Muon Collider Luminosity and Crossing Angle

- Adopt a $\mu^+\mu^-$ 0.6 mrad crossing half angle.
 Lower ϵ_x emittance by 10 to 2.5 mm-mrad.
 Lowers horizontal beam width. $6 \rightarrow 2\mu\text{m}$.
 $\sigma_z = \text{bunch length} = 10000 \mu\text{m}$.
 Piwinski angle = $\varphi \sim (\sigma_z/\sigma_x)\theta$.
 $\varphi = (10000/2)(0.0006) = 3$.
 Lower β_y to $3000 \mu\text{m}$ overlap = $\sigma_x/\theta \ll \sigma_z$.
 Lower ϵ_y emittance by 10 to 2.5 mm-mrad.
- Vary β near IP with 2 sextupoles. *Crabbed*
Waist cuts resonances $\Rightarrow 0.2 \xi_y$ tune shift.
- $6\times$ increased luminosity with $\xi_y = 0.2$
- $L \propto N\xi_y/\beta_y$; get 3 from β_y , get 2 from ξ_y .
- $L \propto N\xi_y/\beta_y$; $\xi_y \propto N\beta_y/\sigma_x\sigma_y\sqrt{1+\varphi^2}$; $\sigma = \sqrt{\beta\epsilon}$.
 Lose 3 from φ . Get 18 from spot size.
- LHC - Ruggiero... PRSTAB, 5 (2002) 061001.